Unified Dirac-Maxwell field as space-time portal

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Abstract

For some time now, a number of similarities have come to light between Dirac's electron theory and Maxwell's theory of electromagnetism. They have found common expression in Dirac's space-time algebra formalism on the one hand, recent experimental proofs of the existence of Maxwellian electro-scalar waves and on the other, an interpretation of the Ahoronov-Bohm effect, leading us to expand and identify the potentials and fields of both these theories and according them full physical reality in the 16-dimensional Clifford space of Dirac's algebra. In a complementary approach, recent theoretical work shows Kerr-Newman's naked singularity, a possible '*ansatz*' to Einstein's General Relativity equations, to be broadly identical with Dirac's electron for the m, a and q parameters corresponding to the experimental particle, comprising 4 distinct states as represented in one vector of state satisfying Dirac's equation. Topological and geometrical analysis of the transit through the microscopic singularity demonstrates that the latter actually constitutes a bridge between two distinct space-time continuums. The final conclusion is that unification of the Maxwell-Dirac field could allow us to envisage theoretical and experimental configurations leading to the exposure and artificial production of analogous singularities with arbitrary properties on the macroscopic scale.

Introduction

Since 1928, the date of publication of Dirac's theory of the electron, a number of authors (3) (8) (11) have established numerous connections between it and Maxwell's theory of electro-magnetism, without ever being able satisfactorily to correlate the components and properties of the two edifices. These two theories have been expressed in various formalisms, the most elegant and powerful being without rival to this day, the space-time algebra (13) formulated by Dirac in order to clarify his solution.

If Maxwell's theory, in its classical form, seems to have been perfectly mastered by the scientific community and also by many users, engineers and students, Dirac's theory, one of the fundamental pillars of quantum mechanics, has by contrast for a long time repelled purists on account of its strongly heterodox geometric appearance as well as on account of the presence of 'imaginary' quantities conflicting with common perceptions of physical reality. It was only through the accuracy of its numeric results in relation to the hydrogen atom that it began to gain respectability, following which many authors (4) (10) (12) (14) have contributed to rendering the content of Dirac's thesis more accessible. Thus eventually the notion of electronic spin, which was unforeseen even by Dirac himself at the outset of his research, came to take centre stage in his findings.

In the course of their efforts to arrive at a description of the electron and its spin by way of general relativity theory, other theoreticians like Kerr and Newman came up with the solution which bears their name, clarifying the space-time metric as generated by a rotating, annular electric charge dependant ultimately on 3 parameters, m, and q, respectively mass, angular momentum by unit of mass, and electric charge (1) (2).

The classical maxwellian theory of electromagnetism, even if thanks to Gibbs and Heaviside logical in its final formulation, declines to take account of the existence of longitudinal electro-scalar waves (5), a phenomenon discovered and extensively explored by Nikola Tesla more than a century ago. Following on from Tesla, an increasing number of other researchers (6) (7) (9), have been trying for several decades to convince the scientific community of the existence of the electro-scalar and purely scalar vibratory degrees of freedom of the Maxwellian field.

At the meeting-point of Dirac's theory with that of Maxwell, Dirac's formalism solves in quite a satisfactory way the problem of the particle in an external electromagnetic field. This electromagnetic field, however, acting as an operator through the action of its potential A on the particle's wave function, seems nonetheless foreign – blended in with it and certainly effective, yet not actually unified to the theory. The interaction between particle and field prompts us nevertheless to call into question our vision of Maxwell's theory, if we look at the effect discovered by Ahoronov and Bohm; in fact, electrodynamicians accustomed to consider as physically consistent only the field and its sources and to ignore potentials, attributed up till now to the proximate gradient of a scalar function, can by means of the Ahoronov-Bohm experiment observe the electromagnetic potential acting alone on the electron and altering the phase of its wave function ψ, in the absence of any field.

Leaving behind any notion of ‘cosmic censorship’ and allowing Kerr-Newman’s naked singularity solution to come forward, Arcos and Pereira (1) explore the domain where $m^2 < a^2 + q^2$, thus reassuming responsibility for the expanded Hawking and Ellis interpretation of Kerr-Newman’s space-time solution and making their own Wheeler's idea of an electron composed purely of field and curvature without any charge or matter. In this hypothesis, the ring singularity of radius $1/m$, which is equal to the Compton radius, encloses a disk, which constitutes the frontier between our space-time continuum and another continuum with similar properties. This ring singularity is depicted as an annular rope traversed by the field rotating at the speed of light, or as an helical rope if the particle is in motion for the observer.

The lines of the electric field are lost in the vortex, disappearing from our space-time on the singularity to reappear on its counterpart in the opposite space-time. When this happens, we, the asymptotic observer, seeing field lines disappear without counterpart, attribute the phenomenon to a q electric charge, knowing that the ring singularity and its enclosed disk are seen by the asymptotic observer as a point and according to a spherical spatial symmetry, this last phenomenon being due to the curvature of the Kerr-Newman solution. The lines of the magnetic field undergo an analogous phenomenon generating the magnetic moment of the electron whose axis is perpendicular to the disk circumscribed by the ring singularity. Besides, the solution includes four distinct states (mass m and - m, spin 1/2 and -1/2), which only turn into themselves after a 4π rotation, a typical property of spinor fields, and leads to the representation of these states into a Lorentz spinor basis. This state vector represents, with a non-vanishing momentum, the complete Kerr-Newman solution within a rest frame of reference and then satisfies Dirac’s equation.

We will therefore utilise all of these considerations and experimental observations in order firstly to expand Maxwell's theory to accommodate the set of the 16-dimensional Clifford space generated by Dirac algebra; secondly, to show that Dirac's theory is only a particular condition imposed on a thus-expanded potential and electromagnetic field, and finally, to show that one can artificially construct, with the help of classical electromagnetic devices, a field-zone on a macroscopic scale comprising all the features of naked Kerr-Newman singularity, in line with Dirac’s condition.

Expansion of the theories of Dirac and Maxwell

Dirac's algebra is generated by the 4 vectors $\gamma_0,\gamma_1,\gamma_2,\gamma_3$ which can be represented by Dirac matrixes. γ_0 squared is equal to 1 and $\gamma_1,\gamma_2,\gamma_3$ squared are equal to -1. The γ_κ are orthogonal, which means they prove :

$$(\mu \neq \nu)(\mu,\nu = 0,1,2,3)$$

$$\gamma_\nu \gamma_\mu + \gamma_\mu \gamma_\nu = 0$$

The γ_κ generate Clifford space $\mathscr{C}_4$ which is 16-dimensionnal and of which a basis is :

$$1, \gamma_0, \gamma_1, \gamma_2, \gamma_3, \gamma_1\gamma_0, \gamma_2\gamma_0, \gamma_3\gamma_0, \gamma_1\gamma_2, \gamma_2\gamma_3, \gamma_3\gamma_1, \gamma_0\gamma_1\gamma_2, \gamma_0\gamma_2\gamma_3, \gamma_0\gamma_3\gamma_1, \gamma_1\gamma_2\gamma_3, \gamma_0\gamma_1\gamma_2\gamma_3 = i$$

All the numbers A belonging to $\mathscr{C}_4$ so called d-numbers are the sum of : a scalar, a vector, a bivector, a trivector and a pseudo-scalar :

$$A = A_S + A_V + A_B + A_T + A_P$$

In classical maxwellian theory, the field F est is defined in relation to the potential A by :

$$\Box A_V = F_B \quad [1]$$

In this case, A_v is a vector (4 components) defined according with a proximate gradient of a scalar function, and F_B a bivector (6 components). The extension conceived by Van Vlaenderen and Waser (6) (7) (9) to include scalar component of the field lead us to write :

$$\Box A_V = F_S + F_B \quad [2]$$

where F_S is the scalar component of the field. This latter has now the 7 expected components and, as demonstrated by our assumption, the potential A_v can no longer be defined according to a proximate gradient of a scalar function !

Considering Kerr-Newman solution described for electron by Arcos et Pereira (1) which leads to two space-time continuums interconnected by the singularity, we may formulate the hypothesis that 16-dimensional Clifford space $\mathscr{C}_4$ as defined above, is the direct sum of four mutually-orthogonal space-time continuum, of which the basis are respectively :

$$\gamma_0,\ \gamma_1,\ \gamma_2,\ \gamma_3$$
$$1, \gamma_1\gamma_0,\ \gamma_2\gamma_0,\ \gamma_3\gamma_0$$
$$\gamma_0\gamma_1\gamma_2,\ \gamma_0\gamma_2\gamma_3,\ \gamma_0\gamma_3\gamma_1,\ \gamma_1\gamma_2\gamma_3$$
$$\gamma_1\gamma_2,\ \gamma_2\gamma_3,\ \gamma_3\gamma_1,\ \gamma_0\gamma_1\gamma_2\gamma_3$$

It is now posible to formulate, according the scheme of Van Vlaenderen and Waser, an equivalent definition of the field from the potential in the continuum of trivectors (dual expression according to our frame of reference: those of vectors). In this case, the scalar component of the field will become pseudo-scalar and we can say :

$$\Box A_T = F_B + F_P \quad [3]$$

Considering [2] et [3] in terms of nature of components of the field, we obtain a definition of the fields from the potentials, which include the two space-times, so :

$$\Box(A_V + A_T) = F_S + F_B + F_P \quad [4]$$

In this définition, our generalized potential for the sum of the two continuum is formally the sum of a vector and a trivector and therefore comprises 8 components. The field, at our second member, sum of a scalar, a bivector and a pseudo-scalar is a biquaternion and also comprises 8 components.

On the other hand let's formulate Dirac equation for a free particle, as described in the references (13) and (14) thus :

$$\Box\Psi = m\Psi\gamma_0\gamma_2\gamma_1 \quad [5]$$

We know that one defines ψ as if it is a biquaternion, thus the sum of a scalar, a bivector and a pseudo-scalar. We also know, referring to chapter 5 (symmetry of the wave function) page 11 of reference (14) that ψ is invariant by multiplication to the right by γ_0 : this means that $\psi\gamma_0$ is also solution of Dirac's equation [5]. In any case, David Hestenes comments as follows :

"This transformation tell us that the Dirac equation does not distinguish (or couple) even and odd spinor fields - a fact which is not discovered and so is not interpreted in the usual form of the Dirac theory. Because of this equivalence of even and odd fields, we may, without further comment, confine the rest of our discussion to transformations which leave ψ even."

Applying this principle of equivalence, we'll use $\psi\gamma_0$ which we'll call Y and seeing that ψ is a biquaternion, its multiplication to the right by γ_0 will generate the sum of a vector and a trivector, thus :

$$Y = Y_V + Y_T \quad [6]$$

We'll also write Dirac equation for Y, thus :

$$\Box Y = mY\gamma_0\gamma_2\gamma_1 \quad [7]$$

We can now say that the Dirac equation we have obtained in [7] is a constraint which can be imposed to the potential (which we attribute to Y) and on the field defined by [4] seeing that A and Y now have both a vector and a trivector part (8 components) as do the second members. And we can write the Dirac condition into A :

$$\Box(A_V + A_T) = m(A_V + A_T)\gamma_0\gamma_2\gamma_1 \quad [8]$$

So we can see that in this expanded theory of electromagnetism, which includes electro-scalar waves, with corresponding, singly-defined potentials according to Van Vlaenderen and Waser, the widening of the theory to include the graded 8-dimensional continuum produced by the direct sum of vectors and trivectors gives us a new electromagnetic potential and field which can support the Dirac condition. The marriage of the Maxwell and Dirac Fields is thus complete and we may go on to consider the Dirac condition as an inter-dimensional solution to the generality of Maxwell equations.

Conclusions

Based on the work of Arcos and Pereira, we formulated the hypothesis that Dirac's equation leads to the description of a field built on two parallel universes, in this case ours (vectors) and its dual (trivectors), in Clifford's algebra terminology. The exterior products of vectors have for a long time held significance in physics but not until now have they been accorded the content of reality that they deserve. The most elementary theory of our space-time (electrons-positrons) demands that they be formally recognised for what they are, virtually fully-formed cosmological parallel universes and not just simple abstract spaces.

For three quarters of a century Dirac's theory and Maxwell's theory have co-existed and if it was impossible until now to unify them, this is because for reasons as obscure as they are strange a whole chunk of electromagnetic reality has been neglected. Ignorance of Tesla and his successors' discoveries (longitudinal and scalar waves) has prevented us for ages from seeing Dirac's theory as a particular case in electromagnetic theory : the inter-dimensional case.

Dirac algebra and more generally Clifford algebras constitute the tool of choice for approaching the multiplicity of continuums. The solution briefly exposed here doesn't limit itself to the continuums of vectors and tri-vectors; the biquaternionic form of the wave function in original Dirac theory also shows us an inter-dimensional door between the two other space-times only briefly touched on in our definition (scalar + the first half of the bi-vector and pseudo-scalar + the second half of the bi-vector).

Comprehensive electromagnetic theory must now take into account the integrality of the 16 dimensions of Clifford space generated by Dirac algebra. Dirac's theory is only a tentative approach to formulate solutions for inter-dimensional fields and its principle could be extended.

Dirac's solution becoming a particular case in electromagnetic theory, it is clear that the wave-function of particles has definitely ceased to be an abstract entity: quantum mechanics is in fact part of extended Maxwell theory !

Since Dirac's field is in fact maxwellian, rotating electromagnetic fields are the key to the synthesis of naked Kerr-Newman singularities such the electron and a number of strange phenomena on a macroscopic scale can be explained by this means. Moreover, it becomes very simple in these conditions to drive a breach between two continuums : only field-geometry seems to intervene. In such circumstances it seems to us nonsense to devise hyper-massive solutions to bend space-time at will while just a few watts of electric power should be sufficient, including in the case of large-scale configurations.

This document is only an interim version : the complete version follows shortly….

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